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HOUSE OF COMMONS SESSION 1992–93

SCIENCE AND TECHNOLOGY COMMITTEE

THE ROUTES THROUGH WHICH THE SCIENCE BASE IS TRANSLATED INTO INNOVATIVE AND COMPETITIVE TECHNOLOGY

MINUTES OF EVIDENCE

Wednesday 19 May 1993

Sir Robin Nicholson and Dr Bill Wilkinson

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WEDNESDAY 19 MAY 1993

Members present:

Sir Giles Shaw, in the Chair

Mr Spencer Batiste	Lynne Jones
Dr Jeremy Bray	Mr Andrew Miller
Mrs Ann Campbell	Sir Trevor Skeet
Cheryl Gillan	Mr Alan W Williams

Memorandum submitted by the Advisory Council on Science and Technology

1. The theme of wealth creation has been central to many of ACOST's activities since its inception. Indeed, wealth creation also featured prominently in the activities of its predecessor body, ACARD, which addressed this issue in its 1985 study of Exploitable Areas of Science. In its advice for the White Paper, ACOST listed the key reasons for spending public money on S&T as:

- To provide world class trained manpower.
- To create an environment which encourages wealth creation and competitiveness.
- To fulfil other societal goals such as improving health and the environment.
- To support the UK position for future collaboration in international programmes, e.g., CERN.

However, it noted that wealth creation was of paramount importance as it represented the well spring for these other key objectives.

2. ACOST has previously set out the framework for its future activities in its 1991 Review of Science and Technology Issues. It concluded that its future work over the following two or three years should be directed mainly at S&T issues which had a direct influence on the competitiveness of the UK economy. This conclusion was supported by the Government's response which indicated that it would be helpful if ACOST could undertake further work on the commercial exploitation of S&T, particularly on:

(i) The scope for developing more effective indicators of the benefits of industrial R&D.
(ii) The factors determining the technological strategies pursued by companies.
(iii) The influence of the economic environment, regulatory environment, management and other factors on investment in innovation, including views on the use of high regulatory standards as a spur to greater competitiveness and innovation.

3. Given the extensive studies on competitiveness and wealth creation conducted by ACOST itself and by many other bodies, it was important to consider whether ACOST could usefully make a further contribution to the debate. Discussions were therefore held toward the end of last year with a range of interested parties including senior Government officials and representatives of the CBI. The response was very positive with the general view being that further ACOST work would be welcome in a number of areas.

4. Accordingly, ACOST has recently established a Working Group on the Commercial Exploitation of S&T under the Chairmanship of Dr Bill Wilkinson. This Working Group proposes to focus on the following issues:

- Quantification of the benefits of industrial R&D and the application of S&T in wealth creation.
- The facilitation of the successful exploitation of S&T, in particular by:
    - Improvement of links between industry, the science base and Government.
    - Improvement of links between industry and the financial community.
    - Improvement in organisation and the use of human resources.
- The effect of fiscal measures on innovation.

ACOST would not claim that these are the only issues which need to be addressed or, indeed, that they are necessarily the most important ones. However, they have all been raised as key issues during consultation and, in addition, they are issues where ACOST feels it has the expertise to make an important contribution.

Moreover, taken together, the issues represent an integrated approach to a complex subject, addressing the environment in which innovative activity takes place, the necessary intermediation of knowledge and skills and the actual outcome of innovative activity in measurable terms.

The cost of printing and publishing these Minutes of Evidence is estimated by HMSO at £880.

Examination of Witnesses

SIR ROBIN NICHOLSON, Chairman and DR BILL WILKINSON, Chairman, Working Group on Commercial Exploitation of Science and Technology, Advisory Council on Science and Technology, were examined.

Chairman

147. Sir Robin and Dr Wilkinson, you are very welcome here. You have been before as I have been reminded; I had actually forgotten, which shows how fast time passes. We are very grateful you have given time to help us in our current inquiry on the subject of the science base and innovative and competitive technology. ACOST has, of course, been reporting on these matters for a long time and have several very important reports already on the record. Your report on advanced manufacturing technology in 1991 made clear that you feel the United Kingdom has failed to maintain its competitiveness. Of course, we also know you are conducting a study in innovation and competitiveness currently, so perhaps we both start from a premise, which is that the United Kingdom tends to need a technologically advanced manufacturing industry if it is to remain competitive. Is this a view you currently share and do you feel—if we could extrapolate that a bit—that the United Kingdom is able to, currently, compete with Germany and Japan in products requiring innovative technology? Are there particular areas, perhaps, in which the United Kingdom experiences difficulty? If we put those little questions all together, you can get a feeling of what we would like to press with you. Would you care to comment?

(Sir Robin Nicholson) First of all, Chairman, thank you very much for your welcome. It is a great pleasure to be in front of this Committee again. As you see, I have with me Dr Bill Wilkinson, who is chairing the working group on the commercialisation of science and technology to which you referred. Obviously, from the comments you have made ACOST and your Committee share the view that innovation is extremely important, has been in the past and will be, increasingly, in the future. You mentioned particularly innovation in manufacturing industry and, obviously, we would agree that is tremendously important, but we would not, I think, want to in any way demote the importance of innovation in the service industries. It is often innovation in the service industries which then brings along innovation in manufacturing industry. For example, the financial services industry has been a very major driver of innovation in information and information systems. Turning to the United Kingdom's performance in this area, I think it has been a theme, not only of ACOST's reports, but of other people's reports, that our performance is like the proverbial curate's egg in that we are very good in parts and less good in other parts. You mentioned competition with countries like Germany and Japan and I think there are certain areas of industry which have profited from technical innovation in a way which is outstandingly good compared with any country in the world, including Japan and Germany and, of course, the United States. These are well known industries such as pharmaceuticals and chemicals and also certain areas of the engineering industry, for example, in aerospace. I think the view which ACOST has developed over a number of reports is that there are some very good and highly innovative companies in the United Kingdom and the problem is that there are just not enough of them and maybe they are rather unevenly spread across the different sectors of industry. For example, it is widely, and I think correctly, believed that the chemistry based industry has been more effective in international competition and innovation than has the physics based industry. I do not think we are faced with a generic problem, but we are faced with a problem that the excellent performance in certain areas of United Kingdom industry is not paralleled by the performance in others and that is the nub of the problem.

Sir Trevor Skeet

148. I wonder if I could ask Dr Wilkinson this? You are looking after this working group on competition and innovation. Do you have any preliminary estimate of the way you are heading at the present moment? Do you have any preliminary results?

(Dr Bill Wilkinson) No. We have only just started, in fact, and have only had one exploratory meeting. We are about to start in earnest this month. One of the things we have set ourselves as a first task is to try and get some hard data on the importance of R&D and the use of science and technology in innovation, to see how important these factors are to the success of the commercial companies. We think we know some of the answers, but we thought the starting point should be to try and get some hard data. That is one of the first tasks, to make sure that the premises on which we are basing our deliberations are correct.

149. May I ask you some further questions on three matters which are of interest to me? Are you going to have a look at whether engineering should have an enhanced status and is that one of the big differences between the United Kingdom and Germany? Would you say that there is something in the change of culture which is necessary to stimulate the United Kingdom compared with America? The third one is whether it would be a good idea to adopt the German practice of having specialists and trained men on boards of directors?

(Dr Bill Wilkinson) To take the first question of status—this is very much a personal view—I think that all professional people get the status they deserve. I do not think we can impose status on any group of people, whether it be engineers, scientists or what have you. I think as far as the second point, the culture, is concerned there is something we need to do there to try to affect a culture change so that the community at large pay more attention to and value more the contribution which science and engineering can make. I think that is a long term issue; once we get that, then engineers will achieve the status which

[Sir Trevor Skeet *Contd*]

their contributions deserve, but I do not think we can impose that on society. Coming to your point about specialists, I have some sympathy with that, but as far as training is concerned one of the points I feel strongly about—and I think ACOST have made this point—is that we tend to miss out in the middle level training. Certainly in many industrial companies there is a vacuum between people with honours degrees and people with nothing and it is in this central region of technicians, skilled craftsmen, and first level supervisors where we in the United Kingdom miss out compared with, say, Germany and Japan.

Mr Williams

150. Do you think that manufacturing is important? Do you think that government properly acknowledges the importance of manufacturing? Looking over the last 10 to 15 years, there was a period in the early 80s when with North Sea oil and service industries, manufacturing did not seem important at all and we lost two million manufacturing jobs and so what? The decline continues in terms of the number of manufacturing jobs and it must be a very difficult kind of background for industrial companies to work in where there were nine million manufacturing jobs in 1979 and there are now five million; unemployment has almost caught up with manufacturing employment. Do you think that the background is right for innovation and growth and applied technology?

(Sir Robin Nicholson) Yes, I do. Obviously, no-one—least of all me—is going to dispute the trends you have talked about, but I think one has to inquire in more detail for the reasons behind them. To answer the very first question you put; yes, I believe the manufacturing industry is tremendously important and the whole of my Council feels that way, but manufacturing industry in the future and in the trends of the last few years is more important for its development of economic growth than it is for the sheer number of people employed. The trend you mentioned—from nine million to five million—is, in part, due to sheer advances in manufacturing technology where, regrettably, the rate of increase in productivity has been greater than the rate of increase in the market and, therefore, fewer people have been needed. Although that has serious social consequences, it is not necessarily a negative trend from manufacturing industry's point of view. Obviously we have to be as efficient as we can. The service industries, it seems to me, are going to be enormously important in the future for the numbers of people employed, but in terms of pounds generated within the United Kingdom, in terms of wealth, then manufacturing industry is going to have to bear the main responsibility for this.

151. I cannot accept that the output of manufacturing industry has scarcely changed from 1979 and our trade in manufactured goods was your main deficit there, but do you think that in the last year or two the government view of things has changed and is now more positive and that with the devaluation last year we are better geared and that there is a better attitude in government? My feeling is that throughout the 1980s manufacturing has not had the importance; I dare say within ACOST, within your own thinking, within your own industries' thinking it may always have been important, but within government it just has not had that recognition. Do you think there has been a change of atmosphere there in the last couple of years?

(Sir Robin Nicholson) Yes, I do. I think ACOST did have the perception—indeed, ACARD previously had the perception—in the 1980s that it was fighting something of a battle against the perception that manufacturing was becoming less important and some time in the middle of the 1980s that battle began to be won. I do not say we were responsible for winning it at all, but it did seem to me that there was a renewed perception of the importance of manufacturing industry. We are talking of perceptions, I have to say. It is very difficult to know what people are thinking and why they are saying what they are, but we did have a perception during the early 1980s that the balance was swinging much more than we believed to be desirable, but we think that has been corrected.

Mr Batiste

152. Coming back a little and drawing on your comments on pharmaceuticals versus engineering, you suggested that we have been successful in one and not so successful in the other. One of the techniques we are using in this Committee in the course of the inquiry is to examine target sectors to see how it is possible to test the various propositions against success or failure in those sectors. Certainly, the success of pharmaceuticals does tend to mitigate against some of the arguments which are generally produced to justify lack of success in the engineering field and, from what we have heard, so far there appear to have been basically three. The first is that it is not actually manufacturing innovation of which we are short; it is the processes and disciplines of the mass manufacturing process in an engineering field where we are not as advanced as countries on the Pacific Rim. The second is that some would argue our financial system is too short-term in its outlook which makes it difficult for companies to invest in R&D. The third, which comes behind it and has been particularly advanced by pharmaceuticals, is that because of their patent protection, once they are in a high risk R&D area they can, if they are successful in a product, determine price levels that will enable them to demonstrate a return to their backers—even though the return may be long-term—in a way manufacturing industry cannot because, generally, it would not have the same patent protection and would be looking at a more competitive edge from its manufacturing process. Those three broad areas seem to be the battle lines which are drawn in assessing the various elements which go towards a successful R&D policy. What would your comments on that be?

[**Mr Batiste** *Contd*]

(Sir Robin Nicholson) They are three very interesting points. I think on the processes and disciplines, there is undoubtedly a difference between the engineering industry and pharmaceuticals. Clearly, one cannot generalise in that sense. I think as ACOST's Advanced Manufacturing Report indicated, we have been relatively less successful both in innovating in advanced manufacturing technology and in putting it into practice for exactly the reasons you have mentioned. I think to put a novel manufacturing process into work requires a level of management commitment and—picking up the point Dr Wilkinson made—an in-depth understanding of what is going on through all levels of a company, which is probably not required in the pharmaceutical industry. Therefore, it is intrinsically a more difficult process. Nevertheless, a number of engineering companies have been extremely successful; it is not that there are none. Some of these are home-grown companies like Rolls-Royce and others are companies which have invested into this country, like IBM and Hewlett Packard and, indeed, the Japanese companies. I do think there is almost certainly truth in what you say; that is, that innovation in the engineering industry is more difficult because of the process discipline. On the third point, the patent protection, it is undoubtedly true that the pharmaceutical industry has been able to take high risks in its R&D because of the likelihood that, in the event they are successful, they have a significant period as a sole supplier where they are able to recoup their investment in R&D. Other companies have done this as well. My own company, Pilkington, has utilised the float glass patent in that way and, certainly, we are not unique in companies outside the pharmaceutical industry. Therefore, I do not think that is all of the story, but it is a feature and I think it is a fact of life that it is much harder to get a watertight patent in areas outside the pharmaceutical industry than it is within it.

153. Would that reflect on the long-term view the City would take in financing those ventures?

(Sir Robin Nicholson) I think it is a factor. My own view of the short-termism problem which you have raised is that it is greater in the perception than in the reality. I have to say that, but I think it is a factor.

Mrs Campbell

154. Sir Robin, I want to ask you about growing high-tech business, which I think you will agree is fundamentally important to our industry. When we visited firms in Cambridge, one of the things they said to us was that there was developing a financing gap. It used to be that the banks financed the low risk start-up industries and the venture capital companies those at the high risk end. There now tends to be more of a gap with many firms falling down the middle. If you think change is necessary, would you prefer a move towards the United States system, which I think is more venture capital based, or perhaps the German system where firms develop a much more long-term relationship with their banks?

(Sir Robin Nicholson) I would hesitate to be prescriptive on anything like that. I think it is horses for courses. I would be in favour of as much diversity in financing as possible, because I really do believe each individual company's needs are very different. If you look at the venture capital scene, people take huge risks in that—huge risks in the United States—knowing that four out of five, or maybe nine out of ten are going to fail, but that the one out of ten which succeeds is going to make a lot of money and they will get a return. That is part of the culture of the United States and I think that sort of culture is growing in this country, but it has a long way to go and I do not see how one could legislate for a rapid increase in that culture. I think it will grow when people are successful and you only have to look at the entrepreneurs of the 1980s who were household names to see that the casualty rate has been quite high, but that is life. If you look back at the history of the industrial revolution—which happened in the 19th century and, indeed, even in the late 18th century—the rate of bankruptcy was very high amongst people who started the industrial revolution. It is a high risk process, but I think that venture capital has a very important role. However, I do think there is scope for other capital where there is a lower risk, but maybe a larger requirement and a lower return. ACOST pointed this out in our report on barriers to growth in small companies. Often you have the venture capitalist going in first and getting shares, effectively very cheaply, and the venture capitalist puts in relatively small sums of money. At that point, the product or products take off and there is a need to finance substantial growth in sales and a lot of working capital is required. There is a need to develop the second and third generation products before the cash is really coming in on the first and that seems to me to be the area where there is the greatest gap. I really agree with you; it is an area about which banks feel a bit uncomfortable because there is very little certainty there and venture capitalists feel uncomfortable because the rewards are much less than those to which they are used. I think if this Committee was able to put forward a blueprint for the type of finance that is needed at that point, it would be very valuable and I think it would lead to a substantial increase in the survival rate of small companies. I do not think we have a problem with the birth rate, if I can put it that way, in small companies. The birth rate is actually quite good. The unfortunate thing is that the death rate in infancy is also quite high.

155. May I just come back on that? What we were told in Cambridge was that this was actually a mistaken perception and that records kept over the past six or seven years showed that the failure rate over that period of time was only about 4 per cent, which may surprise you.

(Sir Robin Nicholson) I think you have to ask yourself whether that particular sample you took at Cambridge is typical. I would think it is probably

[**Mrs Campbell** *Contd*]

untypical in a number of respects. In particular, some of the inhabitants of the various science parks and business parks in Cambridge have been quite well established companies who have seen fit to go there simply to become adjacent to the very high quality knowledge base there is in the city and University of Cambridge. A lot of it is not venture capital in the sense that the Americans would understand it.

Mr Miller

156. Sir Robin, to take you back to your comment to Spencer Batiste when I think you said that issues of short-termism are more in the perception than the reality, perhaps I could put it to you that you may be looking at it from the point of view of the very successful company with which you are associated and not from the needs and interests of the smaller sized companies, many of whom seem to be saying to us that short-termism is a problem. Is it not the case that it is far more difficult in this country for a small entrepreneur to borrow on the long term unless the risk is secured?

(Sir Robin Nicholson) You are absolutely right in your criticism of my comments in the sense that, obviously, each of us looks at this whole situation through our personal experience and my personal experience has been primarily, but not entirely, with large companies. I could not say that it is not more difficult in this country than in country A, B, C. I do not think that is an overwhelming factor in the problem which your Committee is addressing and it is sometimes—not necessarily by members of this Committee—said to be that. Many people will say: "Well, if we could only get over this silly short-termism everything would be all right" and that is what I do not believe to be the case.

157. If you are right—and I think you are—that the birth rate is quite high, the perception appears to be that the death rate is no worse than anywhere else. Maybe what we ought to be looking at is the growth rate of those companies and perhaps that is where the problem lies in terms of medium and long term finance? Is there a weakness there in your perception?

(Sir Robin Nicholson) As I said in answer to Mrs Campbell, I believe that is the case. There is a stage where the risk and reward have reduced to a point where the venture capitalist does not feel entirely comfortable and yet the bank manager of Barclays or Midland is not yet feeling comfortable. I think there is a gap between those two. I agree with that.

158. How do you fill it?

Chairman: Go to Lloyds!

(Sir Robin Nicholson) I think there have been organisations which have attempted to fill it and I think one which has been extremely successful is 3i. It could be argued that we need another half dozen 3i's.

Mr Batiste

159. You referred to the death rate. To what extent do you think that in the United States, where the death rate for these small, highly innovative companies is higher than here, their arrangements for Chapter 11 and, therefore, salvaging the businesses of hi-tech companies that go bust is more effective in maintaining the continuity of that research than our system, with banks having priority and putting receivers in?

(Sir Robin Nicholson) I would not pretend to be an expert in the field. I can only say that my experience of business in the United States, where the companies I am associated with have had links with a number of small companies, that has not been a significant factor. I think the main factor simply is the willingness of people who are moderately rich to invest in these companies, taking a risk, maybe under circumstances of personal taxation which make it desirable or more rewarding and they seem to have a much greater understanding that whatever it is—four out of five, or nine out of ten—will fail. I think the intensive care of a company in Chapter 11 has not, in my perception, been a significant factor there.

Cheryl Gillan

160. I wanted you to give us an opinion and perhaps an evaluation of ACOST since 1987. How successful do you think it has been in ensuring that government is aware of the industrial implications of its science and technology policies? As a postscript to that, when you are talking to government are there any areas where you find it particularly difficult to get the message across? As a third question, in what way would you hope to see ACOST develop?

(Sir Robin Nicholson) I think that since 1987 ACOST has produced a whole variety of reports, some of them quite specific—like the report we did on the UKAEA—and some of them very general, like the one I have just been talking about on the barriers for growth of small firms. Nearly always, because this is the way of life, we are not the only people who are looking and talking about these things. We have had a privileged position in the sense that we have been very close to government and government has, on all occasions that we have requested, agreed to us publishing our reports and has responded to them. However, it is very hard to separate the influence of ACOST from that of many other organisations, not least the Select Committees, because generally these things—as with today's subject—are being thought about by many people at the same time. I believe we have had a significant impact on departmental thinking in its priorities on research and development in a number of areas. I think we have had a significant impact in Health, in Education and Science and in the Environment. Our impact in the Department of Trade and Industry has, in one sense, been almost too great because every time we have made a report, the Department of Trade and Industry has usually produced several new schemes and that can be seen as a very positive response to our report. I feel there is now an element

[**Cheryl Gillan** *Contd*]

of saturation in those schemes and I think the people out there—particularly in small and medium type companies—find the various schemes which the DTI have produced very difficult to understand and to assess their relevance to the particular problem a company may have. About a year ago, as an exercise, we ran through a database for a small company, which we chose to be in Huntingdon, and put the company's needs into that database just to see what would come out; it was an extremely large thickness of paper and one really has to say that in a 100 or 200 person company, with a management of half a dozen, they would find it very difficult to act on it. I should say that was not only DTI schemes; it was also European Community schemes. I think we have influenced departments in a number of ways, but it is difficult to separate our input from that of other people. As far as this government as a whole is concerned, the answer to your question may be easier to give when we see the outcome of the White Paper being prepared by the Chancellor of the Duchy of Lancaster at the moment, but certainly we have not lacked listeners in government. I think ACOST feels it has been listened to; I think ACOST would feel the contact it has had regularly with government ministers and with successive prime ministers has been good, but obviously there are certain areas where we feel dissatisfied and where we seem to have had little impact. Your comment about where we see ACOST going from here, is a matter in the hands of the Chancellor of the Duchy of Lancaster. I do not think it would be appropriate for me to speculate.

Dr Bray

161. You have had the listeners, but have you had the hearers? You have spelt out some of the established wisdom in the scientific and industrial community about what is wrong with innovation and competitiveness in Britain and there are differences of emphasis. You place less emphasis on short-termism—but I do not know anyone who says it is the only answer—and other people place more, but broadly there is a strong consensus outside government. You, as you say, have had the ear of government, but have you been listened to?

(Sir Robin Nicholson) You are distinguishing between listening and hearing, which I find quite difficult.

162. May I give you some examples? On opto-electronics; was not your main recommendation there rejected?

(Sir Robin Nicholson) Yes, it was.

163. On defence R&D; was not your main recommendation there rejected?

(Sir Robin Nicholson) No, I believe our recommendations were met, in part, by the formation of the Defence Research Agency.

164. Is that Charles Reece's view?

(Sir Robin Nicholson) Charles Reece's view?

165. Yes, the Chairman of that Committee.

(Sir Robin Nicholson) I have not asked Charles Reece that question.

166. I do not think it is. On advanced manufacturing technology?

(Sir Robin Nicholson) I think that with the emphasis which the Department of Trade and Industry is now putting on that area and the Science and Engineering Research Council, we would feel that our recommendations have been met, at least in part.

167. On artificial neural networks?

(Sir Robin Nicholson) It is too early to say.

168. The government asked for submissions from all and sundry in response to the Chancellor of the Duchy's questions and among the people who put in evidence are a number of members of ACOST. ICI, with the sources not difficult to guess, said in their submission: "it would be hard to find the folk"—that is, the folk for manning the advisory councils—"unless they felt that this time something will happen." Is there not a high degree of frustration among your members about the reception given to ACOST reports?

(Sir Robin Nicholson) In all honesty I have to say no, there is not a high degree of frustration.

169. Then why did, for example, the President of The Royal Society dissociate himself from the ACOST submission on the Chancellor of the Duchy's questions?

(Sir Robin Nicholson) He did not dissociate himself from the ACOST recommendations.

170. He identified himself with The Royal Society proposals which diverged slightly.

(Sir Robin Nicholson) He said that in one area he preferred The Royal Society's proposals. In other areas, he agreed with ACOST. The ACOST submission on the White Paper covered a vast range of topics and it was not possible for all members of ACOST to agree with every single item, so we agreed that we would form a consensus view and there was no minority report.

171. No, but there was a single principal recommendation for the two research councils.

(Sir Robin Nicholson) I would not regard that as a single principal recommendation.

172. Read in the context of the evidence that came to this Committee, it clearly stood out.

(Sir Robin Nicholson) It was certainly highlighted in the press.

Sir Trevor Skeet

173. May I just make one observation? You say that you have considerable impacts on the departments of State. You have direct access to the Prime Minister. You have a lot of listeners who are prepared to take up the points that you recommend. How is it that we have made such a limited progress

[Sir Trevor Skeet *Contd*]

in bio-technology in the United Kingdom when the responsibilities for that is placed with three departments? Have you tried to correct it?

(Sir Robin Nicholson) We have, since our earlier report on bio-technology, revisited that subject on a number of occasions and made further comments. Certainly, as I think my answers to Dr Bray indicated, it is very rare that a government has embraced an ACOST report and said: "Yes, we agree with everything and we will do that" and I think we would not expect that to happen. There are other factors, apart from those which ACOST is addressing, which influence government's decisions in these areas. However, I think ACOST would feel that since its report on bio-technology there have been a number of very positive factors. There is much more co-ordination of the various people who are involved in bio-technology now—within the research councils—and between the research councils and industry there is much more understanding of the possible role of bio-technology in the future in some of our largest companies and there have been some successful small companies within the field of bio-technology. I think the progress has been positive, but not as fast as we or anybody would have wished. We are not, I think, expecting 100 per cent response; it would be naive if we did.

Mr Miller

174. What, in your opinion, does the State need to do to enable industry to function well in this field? What should be the role of government; an interfacer, a facilitator? If so, at what level and in what particular fields?

(Sir Robin Nicholson) It is an absolutely key question, of course. May I speak generally first and then go back to small and medium-sized companies because you have already picked me up once for generalising? As far as the general situation is concerned, the ACOST view is that the State has four primary ways in which it can positively influence innovation and technical innovation particularly. The first is for there to be steady economic growth, with low interest rates and low cost of money. In other words, economic factors; getting the economic environment right. Innovation, as we are all aware, is a question of balancing risk against reward and the risk which comes in trying to carry out innovation in an economy which is going up and down like a yo-yo is obviously substantially greater than one which is steadily growing. That is point one. On the second point, government is a very important purchaser of goods and services and particularly in areas such as defence and health and various things for local authorities—I should say the public sector, not only government—in transport and I think the government can greatly influence innovation by its role as a purchaser. The third area I would mention is in regulation. I think the changes which occurred in the 1980s, in terms of the liberalisation of the telecommunications market, greatly stimulated innovation in this country in telecoms and telecom equipment. It remains to be seen whether the liberalisation of, say, the markets in power and energy will have the same beneficial effect. Regulation is a very important driver of innovation and I hope that, in the future, regulation of the environment will prove a better driver of innovation than it has in the past. Certainly, that has been the experience in Germany and the Netherlands.

Chairman

175. Sir Robin, do you mean regulation or deregulation?

(Sir Robin Nicholson) I am sorry, I was using the word regulation generically and including regulation and deregulation. I apologise Chairman, I should have said regulation and deregulation throughout.

176. Thank you.

(Sir Robin Nicholson) The fourth and most important point is people. There is certainly evidence, stretching back many years now, that one of the biggest barriers—particularly in smaller and medium-sized companies, but not only in those—is the availability of skilled people and managers who are correctly trained in innovation. Since the government takes a large part of the responsibility for the output of our education system, that is a major area to which it can contribute. These are four areas which are important for all companies. On small and medium-sized companies I would add a fifth area and that is awareness and the point I was making earlier about the sheer difficulty of a small company knowing of all the opportunities and possibilities that are going on.

Mr Miller

177. Returning to the comment you made on the third point on regulation/deregulation, the government has announced, as you know, that they intend to help small and medium-sized enterprises by lessening the burden of regulation, yet I, for one—and I speak for myself and not for the whole Committee—am permanently getting pressures from small businesses about daft regulations from Companies House and things like that which mean they are spending more money on management of bureaucratic systems than in getting on and doing the job they are seeking to do. What areas of deregulation would actually assist this part of the debate we are entering into?

(Sir Robin Nicholson) I think the deregulation in the Telecoms area has been extremely important——

178. May I just interrupt? That has been an important one, yes, but surely that has gone nowhere near far enough in terms of the access of BT, say, to television channels?

(Sir Robin Nicholson) I think all the evidence is that if there was further deregulation in that area there would be further innovation and we would have a more competitive supplying industry across the whole of that area, including television as you

[Mr Miller *Contd*]

mention. Regulation is such a big word. I was talking primarily about regulation and deregulation of an industry rather than a bureaucratic filling in of forms for Companies House, although I certainly agree that deregulation of that is important for small companies as well, as is making it easier for VAT and that sort of thing. I was really talking about regulation and deregulation in the market place and I think one thing we can learn from abroad is the way some of the Continental countries have brought in regulation in the environment in consultation with industry, but not in industry's pocket, so that when the regulations are brought in companies are there and ready with the equipment to allow the other companies to meet them. They are then in a leading position when those regulations spread round the world. Obviously one cannot go wild on this; you cannot have ridiculous regulations coming in which make industry uncompetitive, but as trends develop to improve the environment and health care and all these other things which government has a role in regulating, if it is done in a sensible and forward looking way, it is a great driver of innovation and hence a great driver of economic growth and trade performance.

Dr Bray

179. Could you give us an example?

(Sir Robin Nicholson) Yes, I think the best example——

180. Vehicle exhausts?

(Sir Robin Nicholson) Vehicle exhausts have created a new industry in exhaust control.

181. Building insulation?

(Sir Robin Nicholson) The main drivers in building insulation have been in Germany and Scandinavia and not in this country. Our building regulations are now being improved and I think that will have an effect on innovation. I can think also of emissions; air and water emissions.

Chairman: Let us turn now to international collaboration because it does follow on. A lot of research and development does go on elsewhere; we only have a small proportion of it, but there is a lot we can influence. Mrs Campbell?

Mrs Campbell

182. I am not sure whether this is a question for Dr Wilkinson or Sir Robin. With regard to the ACOST review of science and technology issues, which identifies the need for a more strategic direction to ensure that Britain gains full industrial benefits from its participation in international collaborative research projects and about which we have heard a great deal recently, how great do you feel are the possible benefits from such direction? Do you think that if we put the effort into developing a strategic direction internationally Britain would actually benefit from that?

(Dr Bill Wilkinson) Yes, I think so. In some areas the cost of R&D is so great that no one country can bear it. The fast reactor—although European co-operation is not doing too well at the moment—is a good example of where the entry cost is so large that it makes sense to have international collaboration. I think another good example I can draw from the nuclear industry is in the production of enriched uranium for nuclear reactors. This is an extremely successful collaboration between Germany, Holland and the United Kingdom. Again, it would have been extremely difficult for one of these countries to go it alone because the costs are so great. The Americans did try to go it alone and dropped out because the stakes were too high. The three countries together successfully completed it and are now world leaders in that particular technology, and there are other examples. As the costs of putting R&D into the market place increase dramatically, collaboration is vital in some places.

Chairman

183. May I ask you a question, Dr Wilkinson, which is slightly at a tangent to that? We only have 5 per cent of the world's R&D; there is 95 per cent somewhere else. Do we get a fairly substantial share of that? We are a large international market in relation to investment from overseas, do you reckon we get a fair slug of the R&D through that route, even though it is generated elsewhere?

(Dr Bill Wilkinson) I think that is the point of the question, that we ought to try to get a bigger stake in that. It is extremely difficult to do that unless we have a very good home base. It is very difficult to import technology unless there is some expertise in the country which can receive that technology. Having done that, then I think we could benefit greatly. Multi-national companies do this all the time, very successfully.

Sir Trevor Skeet

184. May I just pursue this point? You talk about the great advantages in enriched uranium, but when it comes to CERN and facilities at Grenoble and ESA, what contracts has the United Kingdom received as a result of its very substantial subscriptions?

(Dr Bill Wilkinson) Up to now, very little, but I think that is so far from the market place that I do not think we are likely to get any large business from it. I think we are still injecting into that.

185. It is a very large part of SERC's budget. They have to pay the subscription and after each devaluation, needless to say, the subscription goes up. Are they getting value for money from this facility? CERN, in particular or ESA?

(Sir Robin Nicholson) I think one has to distinguish between international collaboration which is applied research or even experimental development and international collaboration which is fundamental research. Certainly Sir Trevor is right in saying that in organisations like CERN we have had a small share of the contracts which have gone into CERN, but there is no real commercial outcome

[**Sir Trevor Skeet** *Contd*]

from CERN and, therefore, the issue does not arise. From the point of view of what the Committee is studying, the more important area is a more near-market collaboration. Dr Wilkinson gave the example of enriching uranium and I think we are seeing this now spread very widely. To give one example, the Prometheus programme on advanced automobile navigation is, I think, excellent. I agree very strongly with what Dr Wilkinson said that you can only make a good contribution to that programme and get a good return from it, if you are doing some of it yourself. If you put in peanuts you will get peanuts back.

Lynne Jones

186. We are constantly hearing about the virtues of inward investment for our economy and employment and so on, but can you comment on the effects on innovation and also perhaps—good or bad—what we should guard against and how we can get the maximum use out of inward investment? Also, whether multi-national companies investing in the United Kingdom should have greater access to the science base of this country?

(Sir Robin Nicholson) I think that inward investment historically, not just in recent years, has been a very important source of innovation and advancement in this country. I think if you go right back to the investment by Ford and General Motors you wonder what the British automobile industry would have looked like without that inward investment. More recently, the new investment by Nissan and Toyota has been extremely important. I think the investment in the electronics area from companies such as IBM and Hewlett Packard has been very important, not only for itself in developing innovation in the United Kingdom which is then utilised in products manufactured here, but also in the shape of other companies which are pulled through as suppliers of these companies. It has been an extremely important factor and not least—in fact, probably greatest—in the area which was the very first question the Chairman asked me about engineering manufacturing and the problems we have in getting innovative processes put successfully into practice in the engineering industry. I believe that inward investment, particularly the recent inward investment from Japanese companies, has pulled the average capability in this country up by a tremendous amount, not only——

187. Is that in key innovation, or in other aspects of innovative practices?

(Sir Robin Nicholson) It is in the application and commercialisation of the innovation in the manufacturing process. It is not just finding a better way of making a car mirror, for the sake of argument, it is actually the way you put that into manufacture and carry it right the way through so that it is a profitable product. I am using the words we used earlier in the questions; it is the discipline, the manufacturing discipline of a company's successful innovation and when we were talking earlier about the differences between the pharmaceutical industry and the engineering industry I agreed that I believed it was more difficult to innovate successfully in engineering than in pharmaceuticals. I am sure someone is going to come down on my head like the wrath of God for that, but I do think it is more difficult. Once you have made the innovation, you actually have to put it into a manufacturing process and that requires a cultural attitude and an attention to management of technological change which is way greater than that required to make a different kind of pill.

(Dr Bill Wilkinson) I think people and organisational issues are more important.

Dr Bray

188. This is a two-way process—inward and outward investment—is it not, by multi-national firms? Has Pilkington plans to move some of its research to Brussels?

(Sir Robin Nicholson) No.

189. Some of its development activities?

(Sir Robin Nicholson) No.

190. What were the activities you moved?

(Sir Robin Nicholson) About 30 people were brought from the United Kingdom, Scandinavia and Germany and put in an office in Brussels so that we could market our products on a European basis.

191. Would you expect, for example, ICI's investment in America in drugs for the nervous system to be located there primarily because of the quality of basic research in that area?

(Sir Robin Nicholson) I think most British based multi-national companies decide on the location of their research on a number of criteria of which, obviously, the quality of people available in the country is a very important one and the cost of doing R&D in different countries is also important. However, the most important, in my experience, is the extent to which it is necessary to be near to the market place in order to do the right applied research and development. It is not so important for fundamental research to be done near the market place in which it is going to be used and, indeed, one sees successful fundamental research which is then applied around the world. Going back to some of the examples you gave earlier when you were talking about regulation, if you look at the insulation of buildings and things like that, the requirements in various countries are very different and, therefore, there is a benefit in doing the research and development for that in more than one market place because the market places differ. If I may just generalise the comments, I think that the question of how British based companies distribute their R&D expenditure world wide is obviously one of increasing interest because the more successful British companies are becoming more multi-national. My view is that the criteria which are applied are quality of people, cost of doing the research and benefit of being near the market place.

[**Dr Bray** *Contd*]

Chairman: I would invite the Committee and you, Sir Robin, if I may, to move on as we have still a number of questions to go. May we turn to defence? Mr Miller?

Mr Miller

192. I wanted to ask, Sir Robin, whether you saw some of the issues which emerged out of *The Money Programme* a couple of weeks ago, where GEC and Mr Waldegrave were interviewed? The MoD is one of the single largest customers/purchasers of technology based products in the country. There are historic links between our success at times of crisis in producing high-tech products which have then had spin offs into the civil area. With the fallback in MoD expenditure, which reflects all sorts of things, including the good bits of news coming out of the world from time to time, how do you see things happening in the future? Do you think more needs to be done in the United Kingdom to identify possible civil applications of defence research and how would you see the current system being improved to make the best out of what is happening?

(Sir Robin Nicholson) I think the first comment to make is that there is a tremendous technical resource there and that resource is being used very successfully for the purpose for which it is there, namely defence equipment, not only for use by our armed forces but also, of course, in export. I think the ACOST view is, as we said in our report on defence, that this is an excellent and wholly justifiable use of that resource. However, we do not make as much use as some other countries—the United States in particular—of that resource in civil applications and I think that now with, hopefully, the need for defence equipment reducing and hence the need for defence R&D reducing, there is an opportunity to turn that capability much more to civil applications than has been the case in the past. There are only two ways of doing it, I think. One is to give the Ministry of Defence an increased responsibility to use its technical might to generate more wealth in this country and the second is to say: "Well, you don't need part of the DRA. We will turn it over for civil purposes and we will pass it over to the Department of Trade and Industry or GEC or whoever." Those are the two ways it could be done. Certainly, there is a big opportunity right at this moment to move to that.

Cheryl Gillan

193. As the defence R&D spend reduces and there is a case to increase civil R&D spend, could it not be achieved by using the DTI or the research councils in some way?

(Sir Robin Nicholson) As you are aware, the majority of R&D spend is people and, therefore, when you say use the spend by the DTI that means taking the people who are very skilled—for the sake of argument, taking the RSRE in Malvern—and saying: As from Monday morning, you guys will be part of the DTI and you will be working for wealth creation in the civil sector in the economy." That is a perfectly feasible thing to do; it is not easy, but it is perfectly feasible. The alternative is to say to the Ministry of Defence: "You have this resource. Its sheer size and breadth have great advantages and, therefore, rather than taking little bits away from you, we are going to leave it with you, but we will give you a few additional responsibilities for wealth creation." Those seem to be the two options.

Chairman

194. Can we move on into technology transfer? Do you think the government has a reasonable range of programmes between industry and science? What is your opinion? After all, more could be done surely to make these transfers more effective.

(Sir Robin Nicholson) Fortunately, more can be done to make technology transfer more effective in every country in the world. It is an exceedingly difficult topic and the benefits from doing it better are immeasurable because nobody does it terribly well. Let us get that very clear; it is a very difficult thing to do for a whole host of cultural and technical reasons. The Department of Trade and Industry has developed a number of schemes aimed at enhancing technology transfer and I think that some of these have been successful and some of them less successful. I think the ACOST view would be that probably Link and the Teaching Company Scheme have been the two most successful general schemes and probably Smart and one or two of the small company ones have been also very successful. I think the ACOST view—and certainly, my own view—would be that we should build on the schemes which are successful.

195. Would the responsibility be that of government or industry in this particular area?

(Sir Robin Nicholson) All of us who are working in this field have a responsibility.

196. The responsibility to give the lead?

(Sir Robin Nicholson) I think it has to be a partnership. I made the comment elsewhere that you have the developers of the technology who, if you like, are the transmitters, in broadcasting parlance, and you have the people who need the technology, who are the receivers. You have to look very carefully at each sector to see if you have a shortage of transmitters or receivers. I think it would be the ACOST view that, in the past, the DTI has made a lot of new transmitters where actually there is a shortage of receivers.

Mr Batiste

197. Would it not be equally fair to say that so far as the greater willingness of the universities to collaborate in technology transfer, this has been a by-product? On the one hand, financial stringency and on the other hand, perceived rewards from being more actively involved with industry in general and the two-way flow of people and ideas and money.

(Sir Robin Nicholson) Yes, I think both of those have been important factors and I think that has

[**Mr Batiste** *Contd*]

been a major favourable development in the last 15 years. In addition, I think the recognition by the science community of the role they can play in innovation has increased as well; that has been a third factor which is also very important. All of those things are moving in the right direction. I suppose most of us just feel it would be very good if they could move faster and over a wider area. As I said earlier, we must never forget that there are certain parts of the system where it works extremely well. If you had Richard Sykes here from Glaxo and asked him about technology transfer between the biochemistry base at universities and his company, he would say it was excellent. If it were that good all over British industry we would be enjoying the sun on the terrace instead of sitting here.

Sir Trevor Skeet

198. In one of your reports you called for more research to be undertaken in materials and on the environment. Is there certain implied criticism there about the money you get from the government or is it the fault of ABRC in allocating the funds which are put before it?

(Sir Robin Nicholson) Those comments which ACOST made related not only to the science base funds, but also to departmental funds and certainly we have felt that when new needs have been observed and found, like materials and like the environment, government and its agencies and affiliates have moved slower than some other countries, notably the United States, in taking resources away from programmes which are low priority and putting them into programmes with a higher priority.

199. Yes, but, Sir Robin, last night at the CBI dinner, the Prime Minister talked about the thrust of government, its partnership with industry and all the other private agencies. Are they getting from the government the necessary monies to develop these facilities?

(Sir Robin Nicholson) The government devolves decision making on many of these items to—quite correctly, in my view—well below ministerial level. It is devolved to the Council of the SERC, for example, and it is devolved to individual departments. I do not think it is moving fast enough and that is one of the things that ACOST has said. It is very hard to stop R&D programmes, as we all know. ACOST has stuck its neck out in the past and has indicated that it feels areas like the ones you mentioned—materials and environment, but not only those two—should benefit at the expense of other areas, such as nuclear energy and agriculture, but it is much easier to say than to do.

Chairman: Let us turn now to education and training which we have not touched on yet. Mrs Campbell?

Mrs Campbell

200. About two weeks ago we had some very interesting evidence from NIESR; you may be familiar with their work. One of their main contentions is that British industry is very much hampered by the lack of an adequately trained work force, at the non-graduate level anyway; we will come on to graduates in a moment. Would you agree with that contention and do you think that this is a problem caused by poor schooling?

(Sir Robin Nicholson) Firstly, I do agree that this is a problem and I agree very much with what Dr Wilkinson said earlier that the lack is most keenly felt in the middle range. I do not see evidence that we have too few PhDs, but I do see evidence that we have too few people with City & Guilds and equivalent qualifications to that and it comes back again to the small and medium sized companies. The Glaxos of this world do not, in my view, have a problem; they are able to hire the people they need. I think just before the last period of strong economic growth finished in the late 1980s, even large companies were having difficulties in recruiting people, certainly of the quality they needed. I think the people who have come off worse because of the problem you mentioned are the small and medium-sized companies because, all other things being equal, a graduate will want to go and work for Glaxo, BP or Rolls-Royce or whoever it may be, rather than a small company and once he or she is in that large company they tend not to move to the smaller company. If there were a better balance of demand and supply, I think the main beneficiaries would be the small and medium-sized companies. As far as where the source of the problem is, I think there are many sources. I am sorry to keep on saying this, but I am sure the members of the Committee are well aware that all of the problems you are considering are multi-parameter and multi-body problems and that there is no single solution. I think the quality of science education in schooling has certainly been a problem. ACOST, in its reports on education and training, felt that the government should give a much stronger lead on AS levels and we still take that view. We do not believe that is in any way denying the value of A levels; it is really bringing AS levels up to the same perception as the A levels in the eyes of the school child. At the moment they are regarded by schoolchildren—partly, in our view, as a result of what teachers say and parents feel—as a second best and we feel this is very sad. This is the evidence in Scotland, where the education system is such that if the whole of the United Kingdom had the Scottish education system, life would be a great deal better.

Chairman

201. Could we touch on the graduate problem? You seemed to indicate that you felt the graduate supply in helping industry to develop high-tech industry is reasonably accessible and sufficient. Is that the case?

(Sir Robin Nicholson) I think the graduate supply, broadly speaking, has been sufficient. I think there were signs in 1988/1989 that there was beginning to be a shortage of supply and with the trends in

[**Chairman** *Contd*]

industry and the trends in technology I would expect industry to want to absorb a larger number of people in the future.

Lynne Jones

202. In your answer to the last question, you touched on the submission that you have made for the White Paper on the need to broaden education and reduce factual content, in the hope of encouraging more students to take science and perhaps even have arts students doing a bit of science as well. It remains to be seen what the response to that is going to be or, indeed, what influence the Chancellor has on other areas of education. In terms of innovation, how can the universities best gear themselves up to develop the kind of relationship with industry so that they can take advantage of educated graduates? Many people in industry have commented on the inadequacy of our degree courses; what should those degree courses contain?

(Sir Robin Nicholson) I think inadequacy is a strong word. I would say narrowness of the degree courses. I do not think anybody doubts the quality of our degree courses, but I think many people in industry—certainly, myself included—feel that our courses are too narrow for a large part of the graduate supply into industry and we would feel that some training in the application of science, in its exploitation and in innovative management techniques would suit a typical graduate for a career in industry better than the present very narrow course.

Mr Batiste

203. To what extent do you think that would inevitably involve pushing most of these graduates into fourth year courses which may, in fact, be very difficult for us to fund against what, as far as one can see ahead, is always going to be a fairly difficult public expenditure scenario? Would we not be in danger of throwing the baby out with the bath water and sacrificing the excellence that is produced in our degree courses at the moment and actually watering down the net output of the system as a whole?

(Sir Robin Nicholson) I think our view would be that the system needs to provide a greater range of product, if I might put it that way, and that presently it is rather narrowly focused to a certain type of graduate where the evidence is that the supply exceeds demand. I believe industry would be happy to see an arrangement in which some people did a broader and, inevitably, slightly shallower course over three years and brought in some of the subjects I mentioned and other people did the same depth of course in science and engineering and did a fourth year, in a total technology course or something like that. Still others could do a two year course which would be, as I said earlier in answer to another question, more comparable to a City & Guilds type qualification which is fine for first level supervision in the areas that Dr Wilkinson mentioned. I think it would be possible, within the same total expenditure, to produce a wider range of product—I am sorry to talk about people using this horrible word, but I think it is the right word for the context—which would better meet the needs of the market place and would not cost the system any more.

Chairman

204. You had a working party, did you not?

(Sir Robin Nicholson) Yes, on education and training.

205. In which you suggested a less rigorous three year degree and a fourth year master's course? Is that the sort of thing?

(Sir Robin Nicholson) It suggested that there should be broader training and that if this was at the expense of the number of people who were given three or four years training, then that would be the right thing to do, if we then had some people with two year courses as well.

206. You would not feel that might endanger the skills shortage?

(Sir Robin Nicholson) No, I think it is a better match of supply to demand.

Dr Bray

207. You mentioned the Scottish experience. Over the last two years the number of Scottish graduates going into employment as a first move on leaving, has fallen from something like 57 to 46 per cent and the biggest fall has been in local authority colleges and special institutions and not universities. Would this not run somewhat contrary to your statement that there are shortages in the less highly trained skills, if the higher skilled graduates have the less difficulty in getting jobs?

(Sir Robin Nicholson) I would be very cautious about making a judgment on that on the basis of a couple of years which, hopefully, are not typical. It has obviously been a very difficult period for recruitment of people from tertiary education in Scotland and I do not think ACOST would feel the fact you have given negates our general feeling that the Scottish system produces a range of people with skills which are better matched to the needs of industry than does the English system.

Chairman: Sir Robin, Dr Wilkinson thank you very much. You have answered all the questions we have set and we are very grateful, once again, for your help in our inquiry. The Committee stands adjourned.

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